IN THE SPECIFICATION:

Please amend the Abstract as follows.

~~The invention is related to a~~ A transmitter in which modulator output signal values are generated by a multi-level modulation method. The transmitter comprises ~~means (606)~~ a look-up table for storing a pre-defined number of values corresponding to data symbols and representing a signal or a pulse format, ~~and the transmitter comprises means (602, 604)~~ registers for selecting values representing ~~a~~ the signal or ~~a~~ the pulse format to be used to define in-phase and quadrature component values, ~~values, the transmitter comprises means (602, 604, 606) for defining in-phase and quadrature component values using the selected values corresponding to data symbols and representing a signal or a pulse format, the. The transmitter comprises means (608, 610)~~ and adders for defining the modulator output signal values by summing the in-phase and ~~the~~ quadrature component values while the number of the in-phase and quadrature component values to be summed is determined by [[the]] a number of inter-dependent symbols.

METHOD OF IMPLEMENTING MODULATION AND MODULATOR

[0001] This application is a continuation of international application PCT/FI01/00073 filed January 26, 2001 which designated the US and was published under PCT article 21(2) in English.

BACKGROUND OF THE INVENTION

Field of the Invention:

[0002] The invention relates to a method of generating modulator output signal values when employing a multi-level modulation method, i.e. a modulation method whose signal space diagram has several points depicting a state or level.

Description of the Related Art:

[0003] In digital communications, for instance radio telecommunications systems or optical ~~fibres~~ fibers, the signal being transmitted is typically a carrier signal modulated with information bits. Modulation makes it possible to transfer several signals in one and the same channel on different frequencies. Modulation can be both digital and analogue. Digital modulation methods can be divided into three basic methods which can also be combined: ASK or amplitude shift keying, PSK or phase shift keying, and FSK or frequency shift keying. The amplitude of the carrier is altered in amplitude shift keying, the phase of the carrier is altered in phase shift keying and the frequency of the carrier is altered in frequency shift keying, according to the information bits. In most cases, present radio telecommunications systems use different phase shift keying methods, which include MSK or minimum shift keying, QPSK or quadrature phase shift keying, and OQPSK or offset quadrature phase shift keying.

[0004] The modulated signal is often depicted using a signal space diagram. Figure 1 shows an example of a two-dimensional signal space diagram of a phase-modulated signal, when the modulation has four levels. The system then uses four different signals or pulse formats. In the example of Figure 1, points 100, 102, 104, 106 depict different signals, i.e. states of the signal space diagram. In the signal space diagram, the pointer diagrams of the

[0034] In addition, on the basis of symmetry $c_0(t) = c_0(-t)$, only the first half of the four wave formats needs to be stored and the remaining wave formats are obtained by setting the addresses of the look-up table in reverse order.

[0035] For each 8-PSK-modulated symbol, a corresponding 16-PSK symbol is calculated and then used to decide which one of the four stored wave formats C_1, C_2, C_3, or C_4 of the formula (6) are required to generate the I and Q values and what is the sign of this wave format. Next, the sum expression of the formula (3) is calculated using the stored I and Q values of the four earlier symbols.

[0036] Figure 5 shows one example of a part of a transmitter, which has a modulator of the type described above. The transmitter can be in any apparatus transmitting a digitally modulated signal, such as a mobile phone, palmtop computer or base station. In the example of Figure 5, the in-phase and quadrature components (I and Q components) are modulated separately, but they can also be modulated together.

[0037] The input ~~502~~ 502 of the modulator is a stream of data symbols from DSP (digital signal processing) means 500. In digital signal processing, channel correction action, for instance, is typically performed to compensate for the interference caused by the radio channel to the signal, utilising information received on the channel by means of a known training sequence.

[0038] Both channel and speech coding is also often performed in digital signal processing. A systematic bit redundance, typically parity bits, added to the signal in channel coding are used for error detection and correction in a decoder. In speech coding, generally source coding, the unsystematic redundance in the source symbols is typically eliminated to reduce the required bit rate.

[0039] In addition, in spread-spectrum systems, such as WCDMA (wideband code division multiple access), the spectrum of the signal is by means of a pseudo-random spreading code spread in a transmitter to wideband and despread in a receiver, thus endeavouring to increase the capacity of a channel. Coding can also be used to encrypt the transmission or the information in it. In addition, apparatuses of the GSM system typically include burst formation means which add tail bits of the burst and a training sequence